APPENDIX V

HANTAVIRUS ILLNESS IN THE UNITED STATES

Following is the final electronic text from the Morbidity and Mortality Weekly Report (MMWR) Recommendations and Reports, vol. 42, no. RR-11, dated July 30, 1993. The MMWR is published by the U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention (CDC),
Epidemiology Program Office, Atlanta, Georgia 30333.

SUGGESTED CITATION:
Centers for Disease Control and Prevention. Hantavirus Infection--Southwestern United States: Interim Recommendations for Risk Reduction. MMWR 1993;42 (No. RR-11): [inclusive page numbers].

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These recommendations were developed in part with the assistance of expert consultants during a meeting on rodent ecology and control convened at the Centers for Disease Control and Prevention on July 6,1993.
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Hantavirus Infection -- Southwestern United States: Interim Recommendations for Risk Reduction

SUMMARY

This report provides interim recommendations for prevention and control of hantavirus infections associated with rodents in the southwestern United States. It is based on principles of rodent and infection control and contains specific recommendations for reducing rodent shelter and food sources in and around the home, recommendations for eliminating rodents inside the home and preventing them from entering the home, precautions for preventing hantavirus infection while rodent-contaminated areas are being cleaned up, prevention measures for persons who have occupational exposure to wild rodents, and precautions for campers and hikers.

INTRODUCTION

The recently recognized hantavirus-associated disease among residents of the southwestern United States (1-4) and the identification of rodent reservoirs for the virus in the affected areas warrant recommendations to minimize the risk of exposure to rodents for both residents and visitors. While information is being gathered about the causative virus and its epidemiology, provisional recommendations can be made on the basis of knowledge about related hantaviruses.

These recommendations are based on current understanding of the epidemiologic features of hantavirus infections in the Southwest; they will be periodically evaluated and modified as more information becomes available.

Rodents are the primary reservoir hosts of recognized hantaviruses. Each hantavirus appears to have preferential rodent hosts, but other small mammals can be infected as well (5,6). Available data strongly suggest that the deer mouse (Peromyscus maniculatus) is the primary reservoir of the newly recognized hantavirus in the southwestern United States (1). Serologic evidence of infection has also been found in pinon mice (P. truei), brush mice (P. boylii), and western chipmunks (Tamias spp.). P. maniculatus is highly adaptable and is found in different habitats, including human residences in rural and semirural areas, but generally not in urban centers. Hantaviruses do not cause apparent illness in their reservoir hosts (7). Infected rodents shed virus in saliva, urine, and feces for many weeks, but the duration and period of maximum infectivity are unknown (8-11). The demonstrated presence of infectious virus in saliva of infected rodents and the marked sensitivity of these animals to hantaviruses following inoculation suggests that biting may be an important mode of transmission among rodents (7).

Human infection may occur when infective saliva or excreta are inhaled as aerosols produced directly from the animal. Persons visiting laboratories where infected rodents were housed have been infected after only a few minutes of exposure to animal holding areas (12). Transmission may also occur when dried materials contaminated by rodent excreta are disturbed, directly introduced into broken skin, introduced onto the conjunctivae, or, possibly, ingested in contaminated food or water. Persons have also become infected after being bitten by rodents (13,14).

Arthropod vectors are not known to have a role in the transmission of hantaviruses (7,12). Person-to-person transmission has not been associated with any of the previously identified hantaviruses (9) or with the recent outbreak in the Southwest. Cats and dogs are not known to be reservoir hosts of hantaviruses in the United States. However, these domestic animals may bring infected rodents into contact with humans.

Known hantavirus infections of humans occur primarily in adults and are associated with domestic, occupational, or leisure activities that bring humans into contact with infected rodents, usually in a rural setting. Patterns of seasonal occurrence differ, depending on the virus, species of rodent host, and patterns of human behavior (5,7). Cases have been epidemiologically associated with the following situations:

- planting or harvesting field crops;
- occupying previously vacant cabins or other dwellings;
- cleaning barns and other outbuildings;
- disturbing rodent-infested areas while hiking or camping;
- inhabiting dwellings with indoor rodent populations;

- residing in or visiting areas in which the rodent population has shown an increase in density (15-17).

Hantaviruses have lipid envelopes that are susceptible to most disinfectants (e.g., dilute hypochlorite solutions, detergents, ethyl alcohol [70%], or most general-purpose household disinfectants) (18). How long these viruses survive after being shed in the environment is uncertain.

The reservoir hosts of the hantavirus in the southwestern United States also act as hosts for the bacterium Yersinia pestis, the etiologic agent of plague. Although fleas and other ectoparasites are not known to play a role in hantavirus epidemiology, rodent fleas transmit plague. Control of rodents without concurrent control of fleas may increase the risk of human plague as the rodent fleas seek an alternative food source.

Eradicating the reservoir hosts of hantaviruses is neither feasible nor desirable. The best currently available approach for disease control and prevention is risk reduction through environmental hygiene practices that deter rodents from colonizing the home and work environment.

GENERAL HOUSEHOLD PRECAUTIONS IN AFFECTED AREAS

Although epidemiologic studies are being conducted to identify specific behaviors that may increase the risk for hantavirus infection in humans in the United States, rodent control in and around the home will continue to be the primary prevention strategy (Box 1). CDC has issued recommendations for rodent-proofing urban and suburban dwellings and reducing rodent populations through habitat modification and sanitation (19,20).

Box 1. General precautions for residents of affected areas

- Eliminate rodents and reduce the availability of food sources and nesting sites used by rodents inside the home.
- Follow the recommendations in the section on Eliminating Rodents Inside the Home.
- Keep food (including pet food) and water covered and stored in rodent-proof metal or thick plastic containers with tight-fitting lids.
- Store garbage inside homes in rodent-proof metal or thick plastic containers with tight-fitting lids.
- Wash dishes and cooking utensils immediately after use and remove all spilled food.
- Dispose of trash and clutter.
- Use spring-loaded rodent traps in the home continuously.
- As an adjunct to traps, use rodenticide with bait under a plywood or plastic shelter (covered bait station) on an ongoing basis inside the house.

Note: Environmental Protection Agency (EPA)-approved rodenticides are commercially

available. Instructions on product use should always be followed. Products that are used outdoors should be specifically approved for exterior use. Any use of a rodenticide should be preceded by use of an insecticide to reduce the risk of plague transmission. Insecticide sprays or powders can be used in place of aerosols if they are appropriately labeled for flea control.

Prevent rodents from entering the home. Specific measures should be adapted to local circumstances.

- Use steel wool or cement to seal, screen, or otherwise cover all openings into the home that have a diameter greater than or equal to 1/4 inch.
- Place metal roof flashing as a rodent barrier around the base of wooden, earthen, or adobe dwellings up to a height of 12 inches and buried in the soil to a depth of 6 inches.
- Place 3 inches of gravel under the base of homes or under mobile homes to discourage rodent burrowing.
- Reduce rodent shelter and food sources within 100 feet of the home.
- Use raised cement foundations in new construction of sheds, barns, outbuildings, or woodpiles.
- When possible, place woodpiles 100 feet or more from the house, and elevate wood at least 12 inches off the ground.
- Store grains and animal feed in rodent-proof containers.
- Near buildings, remove food sources that might attract rodents, or store food and water in rodent-proof containers.
- Store hay on pallets, and use traps or rodenticide continuously to keep hay free of rodents.
- Do not leave pet food in feeding dishes.
- Dispose of garbage and trash in rodent-proof containers that are elevated at least 12 inches off the ground.
- Haul away trash, abandoned vehicles, discarded tires, and other items that may serve as rodent nesting sites.
- Cut grass, brush, and dense shrubbery within 100 feet of the home.
- Place spring-loaded rodent traps at likely spots for rodent shelter within 100 feet around the home, and use continuously.
- Use an EPA-registered rodenticide approved for outside use in covered bait stations at places likely to shelter rodents within 100 feet of the home.

NOTE: Follow the recommendations specified in the section on Clean-Up of Rodent-Contaminated Areas if rodent nests are encountered while these measures are being carried out.

ELIMINATING RODENTS INSIDE THE HOME AND REDUCING RODENT ACCESS TO THE HOME

Rodent infestation can be determined by direct observation of animals or inferred from the presence of feces in closets or cabinets or on floors, or from evidence that rodents have been gnawing at food. If rodent infestation is detected inside the home or outbuildings, rodent abatement measures should be completed (Box 2). The directions in the section on Special Precautions should be followed if evidence of heavy rodent infestation (e.g., piles of feces or numerous dead animals) is present or if a structure is associated with a confirmed case of hantavirus disease.

Box 2. Eliminating rodent infestation: Guidance for residents of affected areas

- Before rodent elimination work is begun, ventilate closed buildings or areas inside buildings by opening doors and windows for at least 30 minutes. Use an exhaust fan or cross ventilation if possible. Leave the area until the airing-out period is finished. This airing may help remove any aerosolized virus inside the closed-in structure.
- Seal, screen, or otherwise cover all openings into the home that have a diameter greater than or equal to 1/4 inch. Then set rodent traps inside the house, using peanut butter as bait. Use only spring-loaded traps that kill rodents.
- Treat the interior of the structure with an insecticide labeled for flea control; follow specific label instructions. Insecticide sprays or powders can be used in place of aerosols if they are appropriately labeled for flea control. Rodenticides may also be used while the interior is being treated, as outlined below.
- Remove captured rodents from the traps. Wear rubber or plastic gloves while handling rodents. Place the carcasses in a plastic bag containing a sufficient amount of a general-purpose household disinfectant to thoroughly wet the carcasses. Seal the bag and then dispose of it by burying in a 2- to 3-foot-deep hole or by burning. If burying or burning are not feasible, contact your local or state health department about other appropriate disposal methods. Rebait and reset all sprung traps.
- Before removing the gloves, wash gloved hands in a general household disinfectant and then in soap and water. A hypochlorite solution prepared by mixing 3 tablespoons of household bleach in 1 gallon of water may be used in place of a commercial disinfectant. When using the chlorine solution, avoid spilling the mixture on clothing or other items that may be damaged. Thoroughly wash hands with soap and water after removing the gloves.
- Leave several baited spring-loaded traps inside the house at all times as a further precaution against rodent reinfestation. Examine the traps regularly. Disinfect traps no longer in use by washing in a general household disinfectant or the hypochlorite solution. Disinfect and wash gloves as described above, and wash hands thoroughly with soap and water before beginning other activities.

CLEAN-UP OF RODENT-CONTAMINATED AREAS

Areas with evidence of rodent activity (e.g., dead rodents, rodent excreta) should be thoroughly cleaned to reduce the likelihood of exposure to hantavirus-infected materials. Clean-up procedures must be performed in a manner that limits the potential for aerosolization of dirt or dust from all potentially contaminated surfaces and household goods (Box 3).

Box 3. Clean-up of rodent-contaminated areas: Guidance for residents of affected areas

- Persons involved in the clean-up should wear rubber or plastic gloves.
- Spray dead rodents, rodent nests, droppings, or foods or other items that have been tainted by rodents with a general-purpose household disinfectant. Soak the material thoroughly, and place in a plastic bag. When clean-up is complete (or when the bag is full), seal the bag, then place it into a second plastic bag and seal. Dispose of the bagged material by burying in a 2- to 3-foot-deep hole or by burning. If these alternatives are not feasible, contact the local or state health department concerning other appropriate disposal methods.
- After the above items have been removed, mop floors with a solution of water, detergent, and disinfectant. Spray dirt floors with a disinfectant solution. A second mopping or spraying of floors with a general-purpose household disinfectant is optional. Carpets can be effectively disinfected with household disinfectants or by commercial-grade steam cleaning or shampooing. To avoid generating potentially infectious aerosols, do not vacuum or sweep dry surfaces before mopping.
- Disinfect countertops, cabinets, drawers, and other durable surfaces by washing them with a solution of detergent, water, and disinfectant, followed by an optional wiping-down with a general-purpose household disinfectant.
- Rugs and upholstered furniture should be steam cleaned or shampooed. If rodents have nested inside furniture and the nests are not accessible for decontamination, the furniture should be removed and burned.
- Launder potentially contaminated bedding and clothing with hot water and detergent. (Use rubber or plastic gloves when handling the dirty laundry; then wash and disinfect gloves as described in the section on Eliminating Rodents Inside the Home.) Machine-dry laundry on a high setting or hang it to air dry in the sun.

SPECIAL PRECAUTIONS FOR HOMES OF PERSONS WITH CONFIRMED HANTAVIRUS INFECTION OR BUILDINGS WITH HEAVY RODENT INFESTATIONS

Special precautions are indicated in the affected areas for cleaning homes or buildings with heavy rodent infestations (Box 4). Persons conducting these activities should contact the responsible local, state, or federal public health agency for guidance. These precautions may also apply to vacant dwellings that have attracted numbers of rodents while unoccupied and to dwellings and other structures that have been occupied by persons with confirmed hantavirus infection. Workers who are either hired specifically to perform the clean-up or asked to do so as part of their work activities should receive a thorough orientation from the responsible health agency

about hantavirus transmission and should be trained to perform the required activities safely.

Box 4. Special precautions for clean-up in homes of persons with hantavirus infection or buildings with heavy rodent infestation

- A baseline serum sample, preferably drawn at the time these activities are initiated, should be available for all persons conducting the clean-up of homes or buildings with heavy rodent infestation. The serum sample should be stored at -20 C.
- Persons involved in the clean-up should wear coveralls (disposable if possible), rubber boots or disposable shoe covers, rubber or plastic gloves, protective goggles, and an appropriate respiratory protection device, such as a half-mask air-purifying (or negative-pressure) respirator with a high-efficiency particulate air (HEPA) filter or a powered air-purifying respirator (PAPR) with HEPA filters. Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator practices should follow a comprehensive user program and be supervised by a knowledgeable person (21).
- Personal protective gear should be decontaminated upon removal at the end of the day. If the coveralls are not disposable, they should be laundered on site. If no laundry facilities are available, the coveralls should be immersed in liquid disinfectant until they can be washed.
- All potentially infective waste material (including respirator filters) from clean-up operations that cannot be burned or deep buried on site should be double bagged in appropriate plastic bags. The bagged material should then be labeled as infectious (if it is to be transported) and disposed of in accordance with local requirements for infectious waste.
- Workers who develop a febrile or respiratory illness within 45 days of the last potential exposure should immediately seek medical attention and inform the attending physician of the potential occupational risk of hantavirus infection. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to CDC for hantavirus antibody testing.

PRECAUTIONS FOR WORKERS IN AFFECTED AREAS WHO ARE REGULARLY EXPOSED TO RODENTS

Persons who frequently handle or are exposed to rodents (e.g., mammalogists, pest-control

workers) in the affected area are probably at higher risk for hantavirus infection than the general public because of their frequency of exposure. Therefore, enhanced precautions are warranted to protect them against hantavirus infection (Box 5).

Box 5. Precautions for workers in affected areas who are exposed to rodents

- o A baseline serum sample, preferably drawn at the time of employment, should be available for all persons whose occupations involve frequent rodent contact. The serum sample should be stored at -20C.
- o Workers in potentially high-risk settings should be informed about the symptoms of the disease and be given detailed guidance on prevention measures.
- o Workers who develop a febrile or respiratory illness within 45 days of the last potential exposure should immediately seek medical attention and inform the attending physician of the potential occupational risk of hantavirus infection. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to CDC for hantavirus antibody testing.
- o Workers should wear a half-face air-purifying (or negative-pressure) respirator or PAPR equipped with HEPA filters when removing rodents from traps or handling rodents in the affected area. Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator use practices should be in accord with a comprehensive user program and should be supervised by a knowledgeable person (21).
- o Workers should wear rubber or plastic gloves when handling rodents or handling traps containing rodents. Gloves should be washed and disinfected before removing them, as described above.
- o Traps contaminated by rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or bleach solution. Dispose of dead rodents as described in the section on Eliminating Rodents inside the Home.
- o Persons removing organs or obtaining blood from rodents in affected areas should contact the Special Pathogens Branch, Division of Viral and Rickettsial Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, [telephone (404) 639-1115] for detailed safety precautions.

PRECAUTIONS FOR OTHER OCCUPATIONAL GROUPS WHO HAVE POTENTIAL RODENT CONTACT

Insufficient information is available at this time to allow general recommendations regarding risks or precautions for persons in the affected areas who work in occupations with unpredictable or incidental contact with rodents or their habitations. Examples of such occupations include telephone installers, maintenance workers, plumbers, electricians, and certain construction workers. Workers in these jobs may have to enter various buildings, crawl spaces, or other sites that may be rodent infested. Recommendations for such circumstances must be made on a case-by-case basis after the specific working environment has been assessed and state or local health departments have been consulted.

PRECAUTIONS FOR CAMPERS AND HIKERS IN THE AFFECTED AREAS

There is no evidence to suggest that travel into the affected areas should be restricted. Most tourist activities pose little or no risk that travelers will be exposed to rodents or their excreta. However, persons engaged in outdoor activities such as camping or hiking should take precautions to reduce the likelihood of their exposure to potentially infectious materials (Box 6).

Box 6. Reducing risk of hantavirus infection: Guidance for hikers and campers

- Avoid coming into contact with rodents and rodent burrows or disturbing dens (such as pack rat nests).
- Do not use cabins or other enclosed shelters that are rodent infested until they have been appropriately cleaned and disinfected.
- Do not pitch tents or place sleeping bags in areas in proximity to rodent feces or burrows or near possible rodent shelters (e.g., garbage dumps or woodpiles).
- If possible, do not sleep on the bare ground. Use a cot with the sleeping surface at least 12 inches above the ground. Use tents with floors.
- Keep food in rodent-proof containers.
- Promptly bury (or--preferably--burn followed by burying, when in accordance with local requirements) all garbage and trash, or discard in covered trash containers.
- Use only bottled water or water that has been disinfected by filtration, boiling, chlorination, or iodination for drinking, cooking, washing dishes, and brushing teeth.

CONCLUSION

The control and prevention recommendations in this report represent general measures to minimize the likelihood of human exposure to hantavirus-infected rodents in areas of the southwestern United States affected by the outbreak of hantavirus-associated respiratory illness. Many of the recommendations may not be applicable or necessary in unaffected locales. The impact and utility of the recommendations will be assessed as they are implemented and will be continually reviewed by CDC and the involved state and local health agencies as additional epidemiologic and laboratory data related to the outbreak become available. If required, these recommendations may be supplemented or modified in the future.

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